Dtsch. Entomol. Z. 62 (2) 2015, 123–135 | DOI 10.3897/dez.62.5199

PENSOFT

museum für naturkunde

The Dilaridae of the Balkan Peninsula and of Anatolia (Insecta, Neuropterida, Neuroptera)

Ulrike Aspöck[1,2], Xingyue Liu[3], Horst Aspöck[4]

1 *Natural History Museum Vienna, Department of Entomology, Burgring 7, A-1010 Vienna, Austria*
2 *Department of Integrative Zoology, University of Vienna, Althanstraße 14, A-1090 Vienna, Austria*
3 *Department of Entomology, China Agricultural University, Beijing 100193, China*
4 *Institute of Specific Prophylaxis and Tropical Medicine, Medical Parasitology, Medical University of Vienna, Kinderspitalgasse 15, A-1090 Vienna, Austria*

http://zoobank.org/AE82D0C6-779C-4EAC-A060-824335F79A9B

Corresponding author: *Xingyue Liu* (xingyue_liu@yahoo.com)

Received 27 April 2015
Accepted 19 June 2015
Published 3 July 2015

Academic editor:
Susanne Randolf

Key Words

Dilar
lectotype designation
new species
nomina dubia
Europe
Asia minor

Abstract

Basing upon all available information on type material of *Dilar turcicus* Hagen, 1858, *Dilar syriacus* Navás, 1909, and *Dilar lineolatus* Navás, 1909, together with a large number of dilarid specimens, the pleasing lacewings of Anatolia and Southeast Europe are revised. The current taxonomic concept of *D. turcicus* is confirmed, and a lectotype is designated. *Dilar turcicus* is widely distributed in the southeast of Europe (being the only representative of Dilaridae in this region), in Anatolia, and, most probably, in the Caucasus region. *Dilar syriacus* and *D. lineolatus* remain nomina dubia. *Dilar syriacus* might occur in Anatolia, while *D. lineolatus* is a species occurring in western Central Asia. Two new species, *Dilar anatolicus* **sp. n.** and *Dilar fuscus* **sp. n.** are described from Anatolia. Wings and genital segments of the three species occurring in Anatolia are illustrated, and a map documenting the known distribution of these species is provided.

Introduction

The Dilaridae is a small family of the order Neuroptera comprising about 100 described valid species worldwide. Most species – all assigned to the genus *Dilar* Rambur, 1838 – have been recorded in the Northern Hemisphere, and particularly in Central, East and Southeast Asia (Aspöck et al. 2001, Oswald and Schiff 2001, New 2003, Zhang et al. 2014a, b, c, 2015), but a few species representing other genera, i.e. *Nallachius* Navás, 1909, *Neonallachius* Nakahara, 1963, and *Berothella* Banks, 1934, have been found in North and South America as well as in South and Southeast Asia, respectively (New 1989, 2003, Oswald 1998), and one species has been described from South Africa (Minter 1986).

In the Western Palaearctic most species of *Dilar* have been found in the southwest of Europe in the Iberian Peninsula (Aspöck et al. 2001, Monserrat and Triviño 2013, Monserrat 2014). Only one species – *Dilar turcicus* Hagen, 1858 – has so far been known to occur in the Balkan Peninsula (Aspöck et al. 1980, 2001). This species has also been recorded from various parts of Anatolia. Until now no proven records of other species of Dilaridae in Turkey have been published.

For many years we have, however, been aware of the existence of at least two further *Dilar* species which had been collected by two of us (H.A., U.A.) in Anatolia. However, the fact that the type material of *D. turcicus* had never been examined and the possibility of the occurrence of other described but not identifiable species (nomina dubia) prevented us from describing our unidentified species.

In the course of recent studies on Dilaridae of Asia, we have again examined the situation and have tried to

clarify all open questions as far as possible, so that we can now present a summarising overview on the Dilaridae of Anatolia and of Southeast Europe.

Material and methods

Specimens (partly pinned and dried, partly preserved in alcohol) on which this study is based are deposited in the following collections: Collection of Horst & Ulrike Aspöck, Vienna, Austria (HUAC); Collection of Hubert & Renate Rausch, Scheibbs, Austria (HRRC); Natural History Museum Vienna, Austria (NHMW); Museum für Naturkunde der Humboldt-Universität zu Berlin, Germany (MFN); Muséum National d'Histoire Naturelle, Paris, France (MNHN); Muséum d'Histoire Naturelle, Genève, Switzerland (MHN); Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, U.S.A. (MCZ).

Genitalic preparations were made by clearing the apex of the abdomen in a cold, saturated KOH solution for 3-4 h. After rinsing the KOH with acetic acid and water, the apex of the abdomen was transferred to glycerine for further dissection and examination. Habitus photos were taken by using Nikon D60 and D800 digital camera with Nikon MICRO NIKKOR 105 mm lens, and the genitalic figures of the new species were made by hand drawing under Leica M165C stereo microscope. The genitalia of the lectotype of *D. turcicus* were photographed with a Leica DFC camera attached to a Leica MZ16 binocular microscope and processed with the help of Leica Application Suite. They were then stacked with ZereneStacker 64-bit and processed with Adobe Photoshop Elements 8. The terminology of the genitalia generally follows U. Aspöck and H. Aspöck (2008).

Distribution map: Localities were taken from original literature (Suppl. material 1) and, together with the specimens examined by us, listed continuously with a number for each locality in MS Excel 2010 (Suppl. material 2); geographic coordinates introduced by us are in italics.

Taxonomy

Genus *Dilar* Rambur

Dilar Rambur, 1838: 9. Type species: *Dilar nevadensis* Rambur, 1838: pl. 9 (monotypy).
Cladocera Hagen, 1860: 56. Nomen nudum.
Lidar Navás, 1909: 153. Type species: *Dilar meridionalis* Hagen, 1866: 295, original designation.
Fuentenus Navás, 1909: 154. Type species: *Dilar campestris* Navás, 1903: 380, original designation.
Nepal Navás, 1909: 661. Type species: *Nepal harmandi* Navás, 1909: 661, original designation.
Rexavius Navás, 1909: 664. Type species: *Dilar nietneri* Hagen, 1858: 482, subsequent designation by Navás, 1914: 10.

Note. A description of the genus has been given on several occasions in recent publications (Zhang et al. 2014a, b, c, 2015). *Dilar* occurs in the southern parts of Europe (Spain, Portugal, France including Corsica, Italy including Sardinia, Croatia, Bosnia-Herzegovina, Montenegro, Macedonia, Bulgaria, Kosovo, Albania, Greece including several western and eastern islands, Ukraine, Russia); Northern Africa (Algeria, Tunisia); Asia (Turkey, Lebanon, Iran, Afghanistan, Turkmenistan, Kyrgyzstan, Tajikistan, Nepal, Pakistan, India, Sri Lanka, China, Korea, Japan, Thailand, Vietnam, Malaysia).

Dilar turcicus Hagen, 1858

Figs 1–10; 31

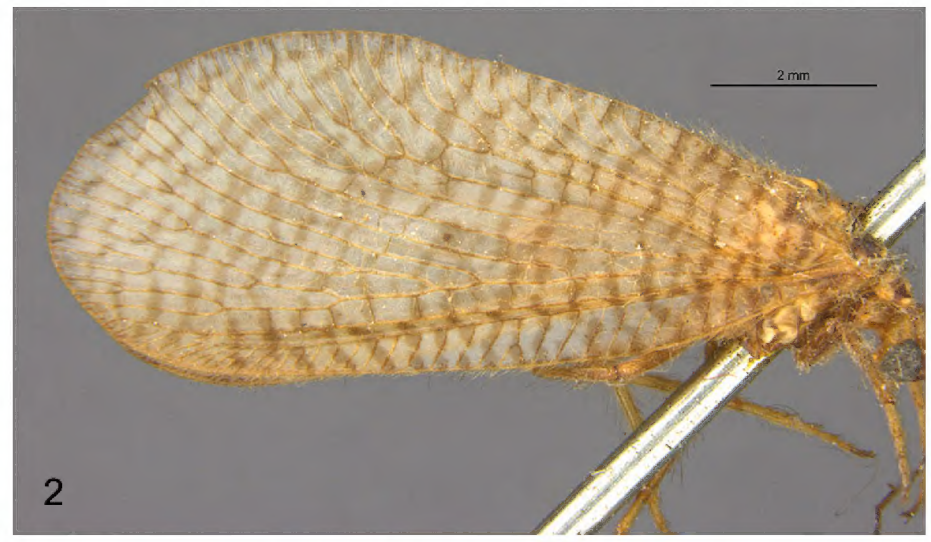
Dilar turcicus Hagen, 1858: Navás 1909, Aspöck et al. 1980, Aspöck et al. 2001.
Dilar corcyraeus Navás, 1909: Aspöck et al. 1980.

Remarks. After the original description by Hagen (1858) based upon two specimens, one from Turkey and one from Armenia, the species was redescribed, characterised and/or illustrated on several occasions (e.g. Navás 1909, 1914, Aspöck et al. 1980), but none of the two syntypes has ever been examined. When we realized that Anatolia harbours at least one further species of *Dilar* which could not be differentiated eidonomically from *D. turcicus*, an examination of the types became necessary. Both syntypes still exist. The syntype from Turkey ("Türkei", Smyrna [=Izmir] written on the original collecting label) is preserved in MFN in Berlin. Unfortunately, this specimen consists only of fragments of the wings (Fig. 8), which do not allow a definite identification. Therefore, we tried to examine the other syntype, which is from Armenia ("Armenien", without further details on the locality). This syntype is deposited in the MCZ[1] of the Harvard University in Cambridge and was kindly sent to us for examination. The specimen is a male in a fairly good condition (Figs 1–7), although it lacks the left fore- and hindwings. In particular, the abdomen is present so that we could study the genital segments. They agree perfectly with the genital segments of that species which has been regarded as *D. turcicus* Hagen until now (see Fig. 439 in Aspöck et al. 1980). We herewith designate the syntype from "Armenia" as the lectotype of *Dilar turcicus* Hagen, 1858.

D. turcicus shows a considerable variation in size and coloration of wings. Lengths of forewings vary from 7.5 to 13.5 mm. A reliable identification seems – at least presently – only possible on the basis of the male genital segments.

Distribution. As far as we know the southeast of Europe does not harbour any other species besides *D. turcicus*. We have examined more than 200 specimens from various localities on the Balkan Peninsula and have not

[1] Hermann August Hagen (1817–1893) moved from Germany to Cambridge, Mass., USA in 1867, where he became the first professor of entomology in the USA. He took (at least parts of) his collection with him to the Museum of Comparative Zoology, where it is still preserved.



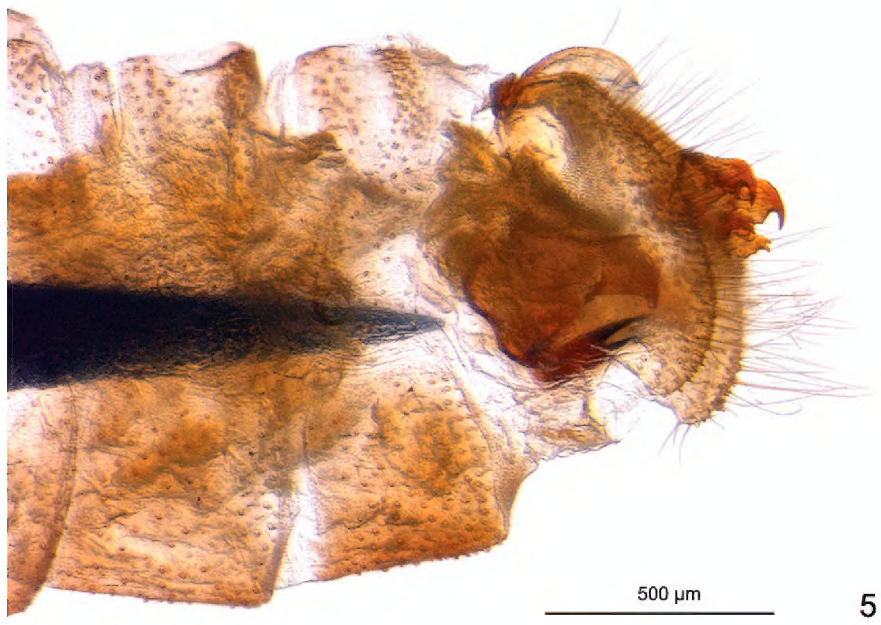
Figures 1–4. *Dilar turcicus* Hagen, lectotype, male (MCZ, Cambridge). **1.** Habitus, lateral view from left; **2.** Habitus, lateral view from right; **3.** Head, frontal view; **4.** Labels.

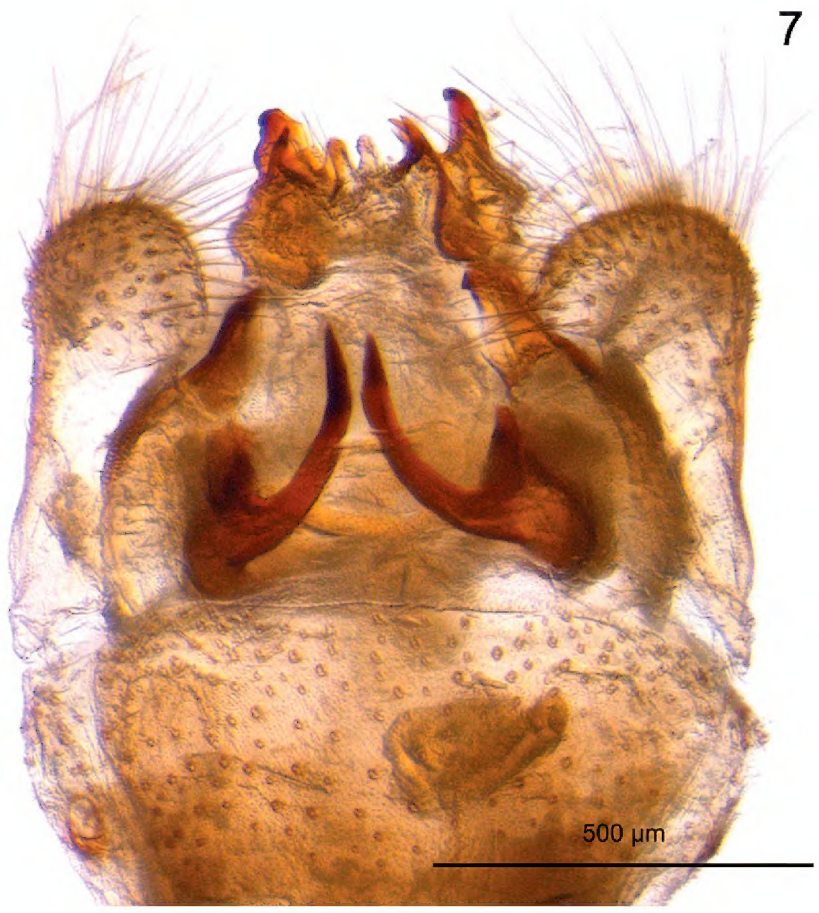
found any hint for the occurrence of a second *Dilar* species. Thus, it is a reasonable assumption that all published records of *D. turcicus* from localities situated in Europe really refer to this species. We have therefore included all published European records of *D. turcicus* in the map (Fig. 31). All records outside Europe (mainland) are based upon specimens examined by us. The documented distribution (Suppl. materials 1 and 2) comprises: Croatia, Bosnia-Herzegovina, Montenegro, Kosovo, Macedonia, Albania, Greece including several islands (Corfu, Chios, Skopelos, Samothraki, Thasos, Lesbos), Bulgaria, Ukraine, Russia, Turkey (Aspöck et al. 1980, 2001; Devetak 1991, 1992a, b; Devetak et al. 2015; Ghilarov 1962; Pongrácz 1913; Popov 1964, 1993, 2001, 2002, 2004, 2007; Zakharenko 1982, 1988; Zakharenko and Krivokhatsky 1993; specimens examined in the course of this study are listed in Suppl. material 2).

The exact type locality of *D. turcicus* remains unknown. In the middle of the 19th century the name Armenia was used also for regions in the east of Anatolia. Whether *D. turcicus* occurs in Armenia of present time is not sure. However, Ghilarov (1962) described the larva of *D. turcicus* from the Caucasus region, not far away from the proven record of *D. turcicus* in the Crimean peninsula. Thus, one can hardly doubt that *D. turcicus* occurs in present day Armenia. There are also several published records of *D. turcicus* in Anatolia (Kiyak and Özdikmen 1993, Canbulat and Kiyak 2005, O.B. Kovanci and B. Kovanci 2015, Canbulat 2007). However, these records could not be checked by us and have therefore been included in the distribution map as *Dilar* sp.

Dilar corcyraeus has already been synonymised 35 years ago (Aspöck et al. 1980). It was described on the basis of a single female, which is deposited in the NHMW, Vienna. The type locality is the Greek island of Corfu, from where also *D. turcicus* has been recorded (Aspöck et al. 1980). Navás (1909) himself had already considered that it might be a variety of *D. turcicus*. Here we provide a photograph of the type of *D. corcyraeus* (Fig. 9).

Biology. The biology of *D. turcicus* is poorly known, with only a few scattered observation records (Ghilarov 1962; Aspöck et al. 1980; New 1986). Adults are usually found on shady places with rich low vegetation, bushes and trees, frequently near stone walls with numerous crevices where the larvae may pupate after their development in the soil. The number of larval instars is unknown, but up to 12 moults have been observed under experimental conditions (New 1986). However, there is no indication that the number surmounts the three instars known from Neuroptera under natural conditions. Duration of development from egg to adult is probably at least one year. Adults are mainly active after sunset and are attracted by artificial light. *Dilar turcicus* has a considerably





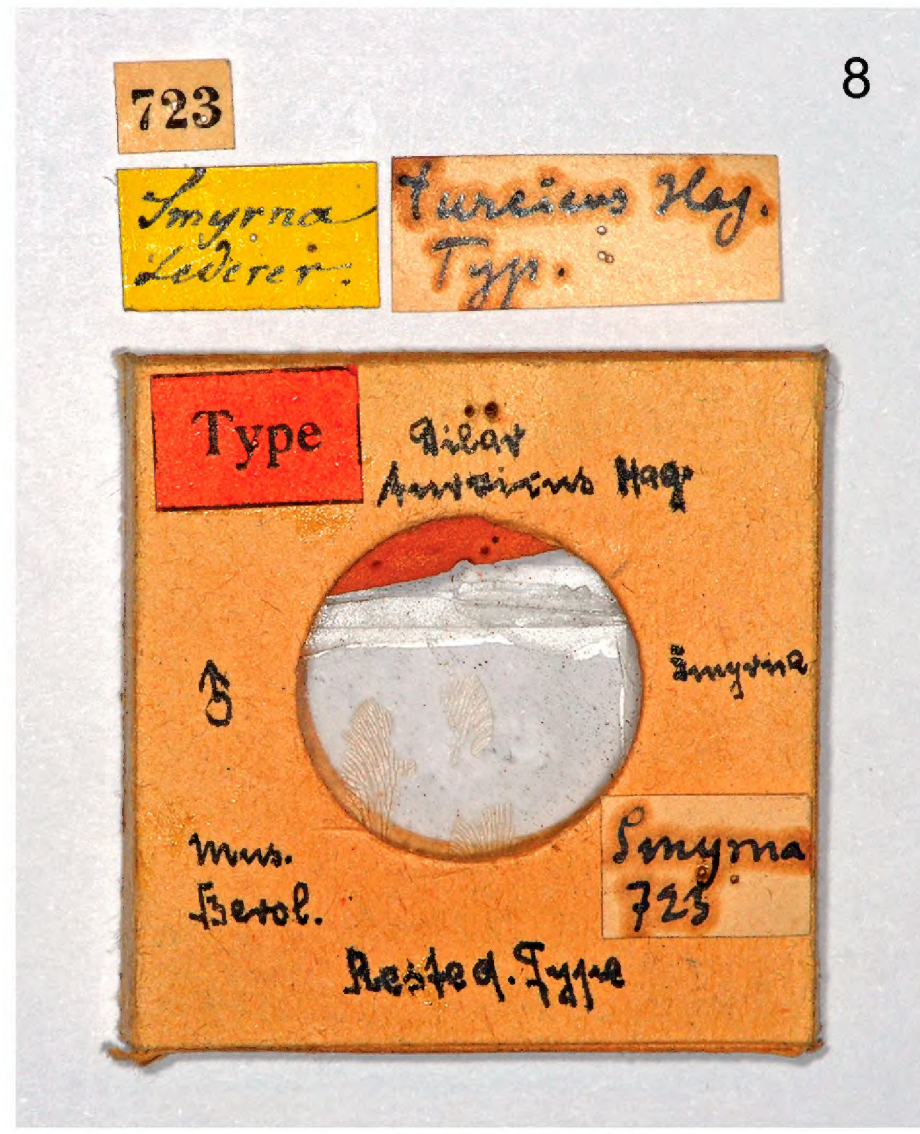


Figure 8. *Dilar turcicus* Hagen, syntype [now paralectotype] male (MFN, Berlin). Fragments of wings and labels.

Figures 5–7. *Dilar turcicus* Hagen, lectotype, male (MCZ, Cambridge). **5.** Genital segments, lateral view; **6.** Genital segments, dorsal view; **7.** Genital segments, ventral view.

Figures 9–10. *Dilar turcicus* Hagen, holotype female of *Dilar corcyraeus* Navás (NHMW, Vienna). **9.** Habitus (The abdomen is preserved in a vial in glycerine), dorsal view; **10.** Labels.

large vertical distribution, with records ranging from few meters up to 2100 m above sea level.

Dilar syriacus Navás, 1909

Dilar syriacus Navás, 1909: Navás 1913, 1914, 1925, Monserrat 1988, Legrand and Lachaise 1994, Oswald 1998.

Remarks. This species has been described based on a single male specimen without abdomen deposited in the MNHN, Paris. According to the description of Navás (1909), the specimen resembles *D. turcicus*. As the type lacks the abdomen, it cannot be identified reliably. Therefore, Monserrat (1988) has declared *Dilar syriacus* as a nomen dubium, which was confirmed by Legrand and Lachaise (1994). The type was collected most probably near Beirut. Perhaps it will be possible to clarify the species as soon as one can collect there and find out which species occur in the surroundings of Beirut.

Dilar lineolatus Navás, 1909

Figs 11–13

Dilar lineolatus Navás, 1909: Navás 1914, Monserrat 1988, Oswald 1998.

Remarks. This species was described on the basis of a specimen from "Turkmenien (Tekke)". Turkmenien is the old German word for that part of western Central Asia which is largely identical with the present Turkmenistan. In his description of the species Navás (1909) translated "Turkmenien" as "Turcomania". Later "Turcomania" was erroneously interpreted as Turkey by Oswald (1998). "Tekke" is a frequent geographic name also in Anatolia, and thus Oswald (1998) decided to choose a locality named "Tekke" situated in Turkey as the type locality of *D. lineolatus*. He even gave the geographic coordinates: 40°09'N/29°41'E, which is certainly wrong. Possibly, Oswald's (1998) interpretation gave rise to the subsequent records in Anatolia (Canbulat and Kiyak 2005). We do not think that *D. lineolatus* really occurs in Turkey. The type locality of *D. lineolatus* should be somewhere far more in the east.

The holotype of *D. lineolatus* (Figs 11–13) is in poor condition. It is a female, but it lacks the abdomen. Only one forewing and the hindwings are present. We (H.A. & U.A.) examined this specimen already in 1967 (H. Aspöck and U. Aspöck 1968) and our opinion on this species of that time can now be confirmed: *D. lineolatus* is a valid and distinct species and cannot be assigned to any of the species recorded from Western and/or Central Asia. The coloration of the wings and of the wing venation is rather dark and characteristic so that it may be possible to clarify the species. However, at present *D. lineolatus* has to be regarded as a nomen dubium, because due to the lack of the genitalia a clarification of the taxonomic status of this species is not possible.

Figures 11–13. *Dilar lineolatus* Navás, holotype, female (MFN, Berlin). **11.** Left forewing; **12.** Right hindwing; **13.** Labels.

Dilar anatolicus sp. n.

http://zoobank.org/9A9EC5E2-270A-43FC-ADE3-6459233F89A9

Figs 14–25; 31

Diagnosis. This species is characterized by the forewings with numerous pale brown spots and by the male gonocoxite complex 9, 10 and 11 with short, feebly sclerotized ninth gonocoxite and elongate, blade-like tenth gonocoxite.

Description. Male. Length of forewing 11.0–12.2 mm, of hindwing 9.5–10.3 mm.

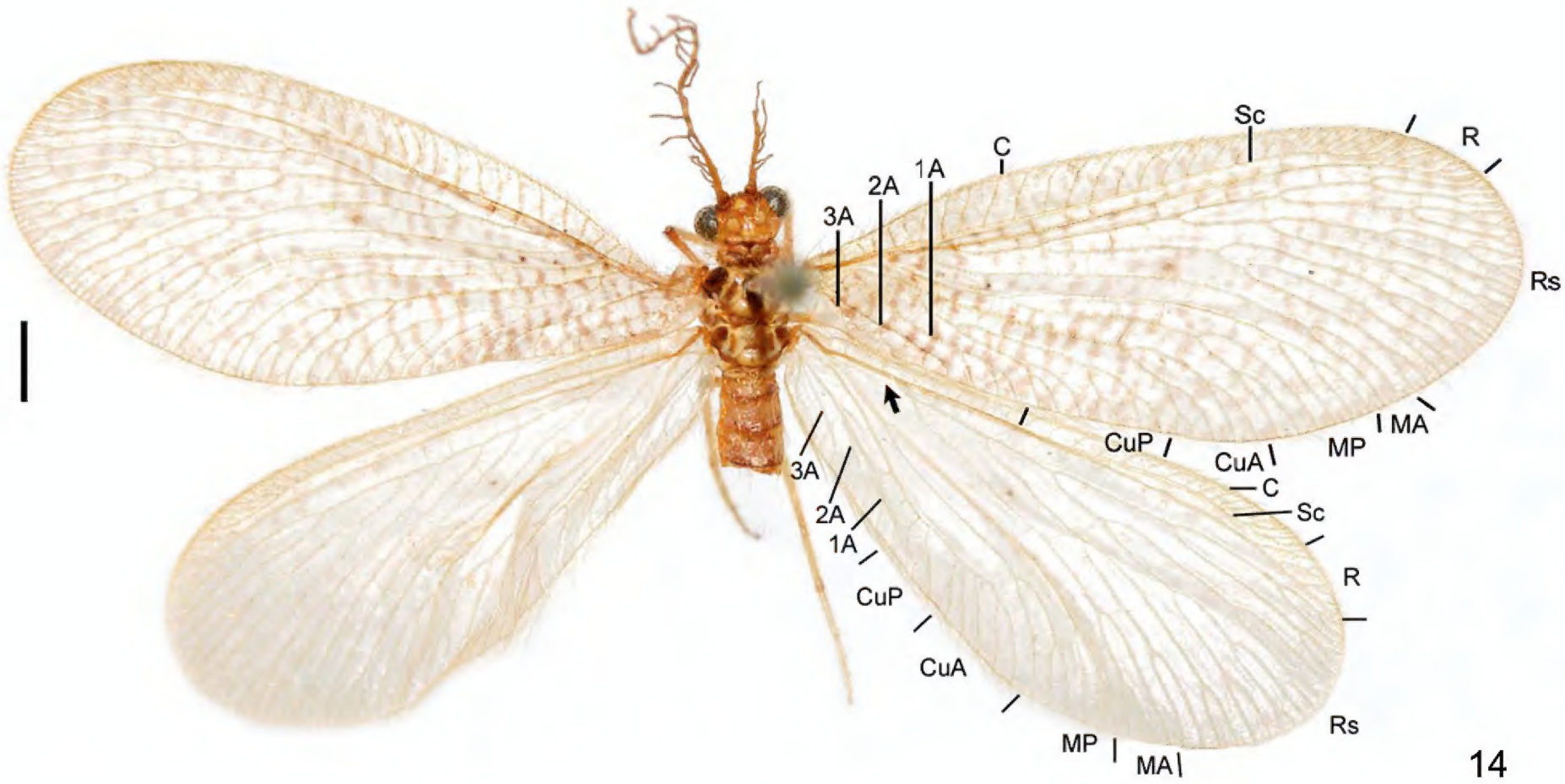
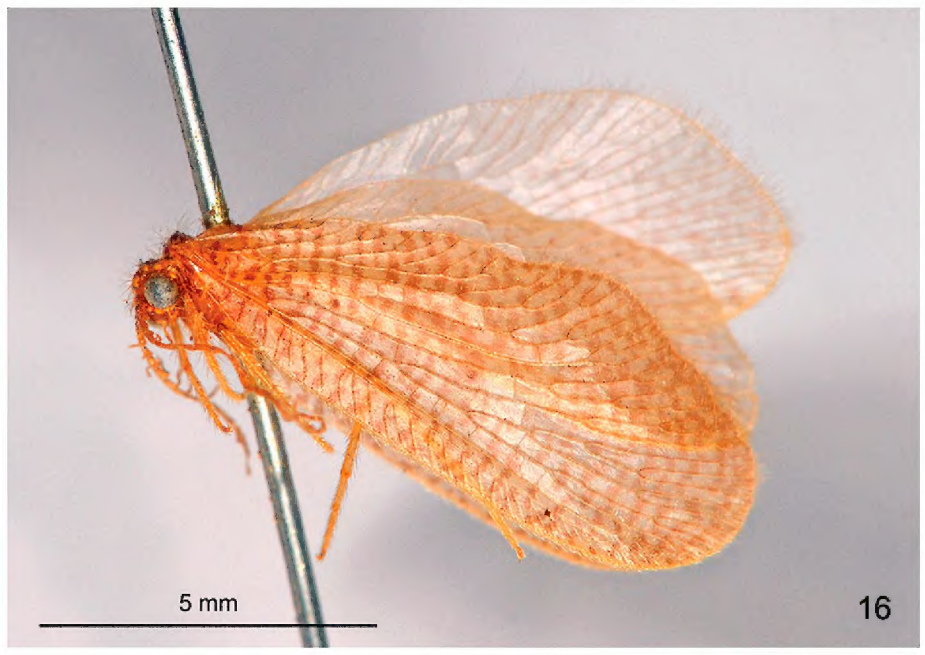


Figure 14. *Dilar anatolicus* sp. n., holotype, male (HUAC, Vienna), habitus. Arrow indicates base of hindwing MA vein. Scale bar = 1.0 mm.

Figure 15. *Dilar anatolicus* sp. n., paratype, female, habitus (HUAC, Vienna). Scale bar = 1.0 mm.

Head pale yellowish brown, with pale yellow setose tubercles. Compound eyes blackish brown. Antenna with ca. 29 segments, pale yellow, with scape and pedicel pale brown, flagellum unipectinate on most flagellomeres, medial branches much longer than those on both ends, longest branch nearly 3.0 times as long as the corresponding flagellomere, but branch of 1st flagellomere short and dentate, distal eight flagellomeres simple.

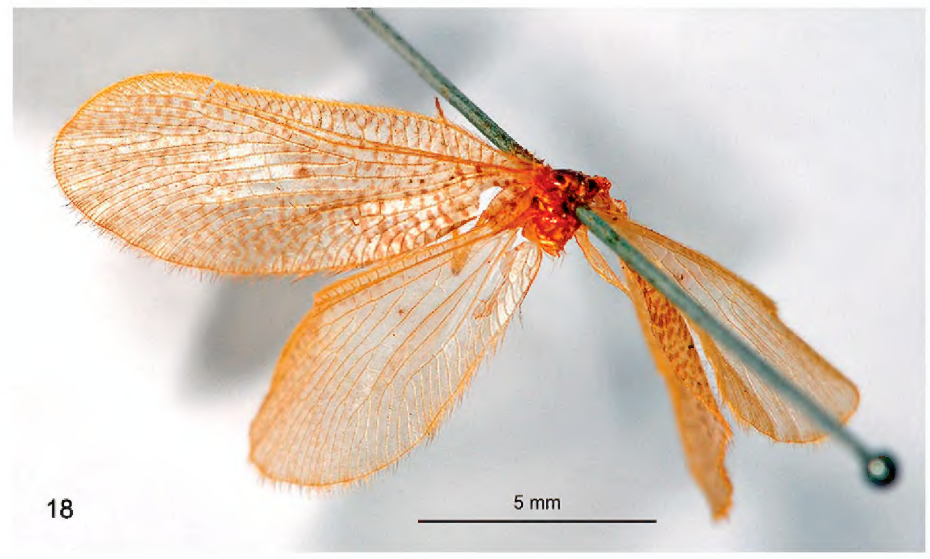
Prothorax pale yellowish brown, pronotum dark brown with several hairy yellowish tubercles; meso- and metathorax yellow, each notum laterally with a pair of broad, brown markings and a pair of pale brown narrow stripes; mesonotum medially with a pair of additional brown markings near anterior margin. Legs pale yellow, with femora blackish brown at tip. Wings hyaline, slightly yellowish brown, with numerous pale brown spots. Forewing ~2.5 times as long as wide, densely spotted, with markings slightly darkened toward anal region; a few markings on posteroproximal area connected with each other, forming short transverse stripes; an immaculate area present distal to median nygma; two nygmata present on proximal portion, both slightly smaller than

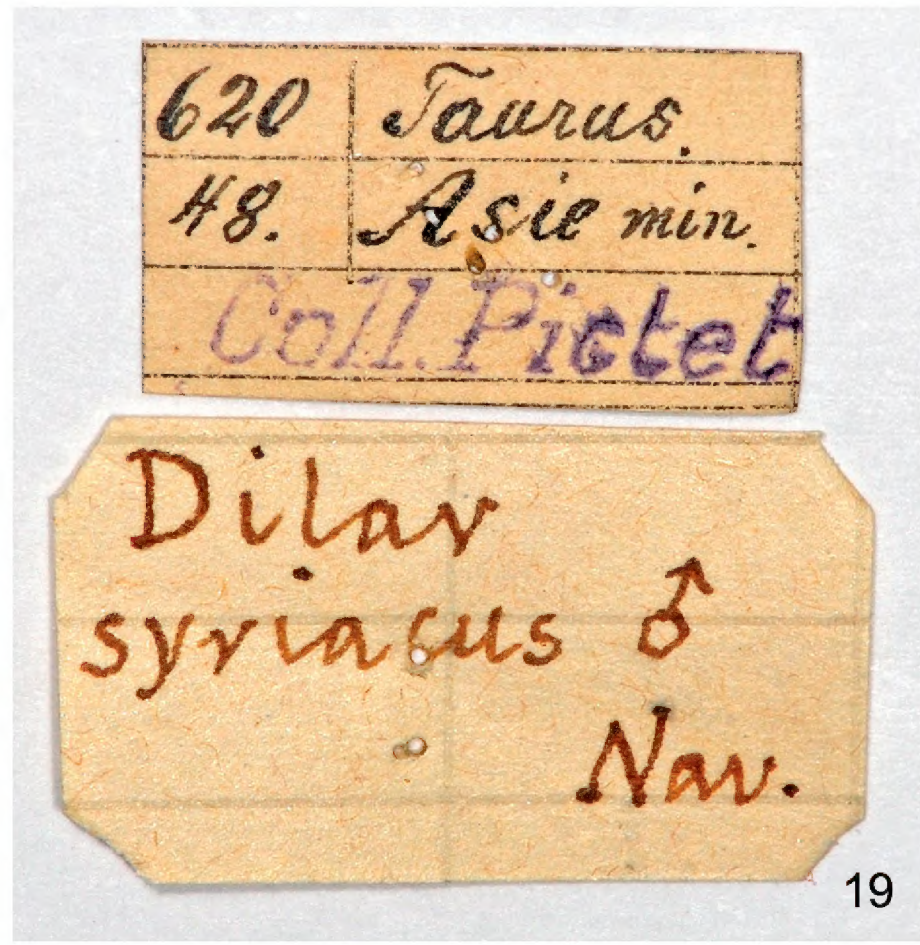


Figures 16–17. *Dilar anatolicus* sp. n., paratype, male (MFN, Berlin). **16.** Habitus, lateral view from left; **17.** Labels.

median nygma. Hindwing ~2.1 times as long as wide, slightly paler than forewing, with dark markings largely reduced; one nygma present at middle. Veins pale yellowish brown; Rs with four main branches on both fore- and hindwings.

Abdomen pale yellowish brown, pregenital segments dorsally brown. Ninth tergite in dorsal view with nearly truncate anterior margin and a deeply V-shaped posterior incision, leaving a narrow median portion and a pair of subtriangular hemitergites, which are obtuse and slightly incurved distally; in lateral view broad, with straight ventral margin and arcuate posterior margin. Ninth sternite obviously shorter than ninth tergite, with nearly truncate posterior margin. Ectoproct in dorsal view with a pair of digitiform projections, posteroventrally with a pair of subsemicircular and flattened lobes, a pair of bifid unguiform projections and a pair of short, feebly





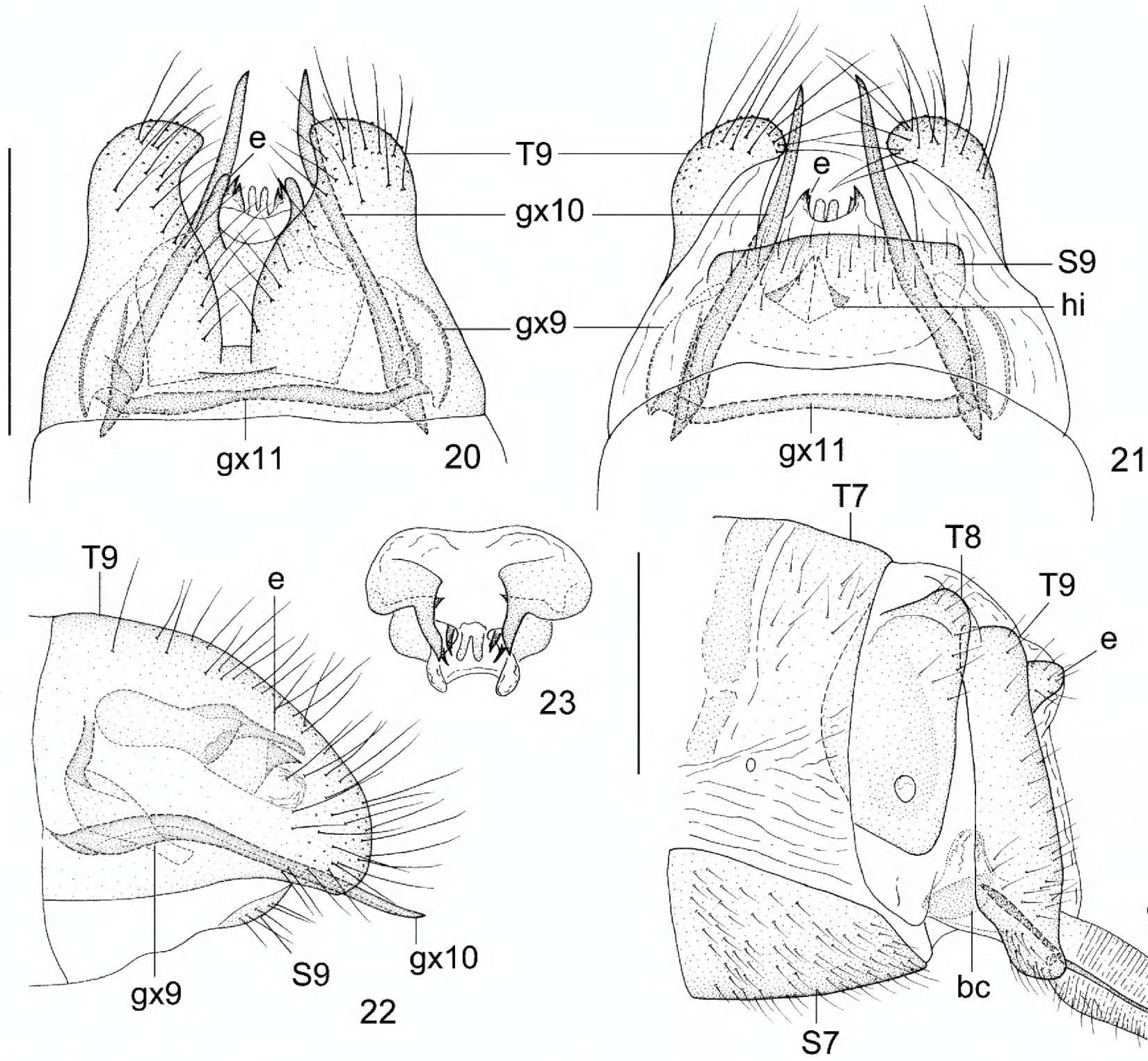
Figures 18–19. *Dilar anatolicus* sp. n., paratype, male (MHN, Genéve). **18.** Habitus; **19.** Labels.

sclerotized, digitiform projections. Ninth gonocoxite short, shield-like, mostly membranous and transparent, with sclerotized lateral margin and with a strongly narrowed, obtuse apex; tenth gonocoxite slenderly elongate, blade-like, nearly 2.5 times as long as ninth gonocoxite, straightly directed posteriorly with median portion feebly curved; fused eleventh gonocoxites (= gonarcus) beam-shaped, laterally connectedto base of ninth gonocoxites. Hypandrium internum subtriangular, with lateral margins slightly arcuate.

Female. Length of forewing 10.9 mm, of hindwing 10.0 mm.

Seventh sternite in lateral view subtrapezoidal. Eighth abdominal segment without subgenitale. Basal part of bursa copulatrix sac-like, nearly rhomboid in ventral view, proximally membranous and strongly rugose, distally sclerotized into a pair of lateral sclerites and a median ridge. Ectoproct rather small, ovoid.

Type material. Holotype ♂, "Asia minor, Kizilçahamam [a district of Ankara Prov., 40°28′N, 32°38′E], 1200 m, 7. 70 / G. Friedel leg." (HUAC). Paratypes: 1♀, same data as holotype (HUAC); 1♂, "ANATOLIEN, Icel, Kilik. Taurus, Namrun [a town of Toroslar Dist., Mersin



Figures 20–25. *Dilar anatolicus* sp. n. **20.** Male genitalia, dorsal view; **21.** Male genitalia, ventral view; **22.** Male genitalia, lateral view; **23.** Male ectoproct, caudal view; **24.** Female genitalia, lateral view; **25.** Bursa copulatrix, ventral view. bc: bursa copulatrix; e: ectoproct; gx9–11: ninth to eleventh gonocoxites; hi: hypandrium internum; S7–9: seventh to ninth sternite; T7–9: seventh to ninth tergite. Scale bars = 0.5 mm.

Prov.], 37.03N, 34.46E, 1400-1800 m, 18.VI. / TÜRKEI, ANATOLIEN 1979, C. Holzschuh & F. Ressl" (HUAC); 1♂, "ANATOLIEN, Bursa, Uludağ, 700 m, 40.12N, 29.04E, 6.VII. / BULGARIEN-TÜRKEI-GRIECHENLAND-EXP. 1978, H. & U. ASPÖCK, H. & R. RAUSCH, P. RESSL" (HUAC); 3♂1♀, "As[ia]. Min[or]. Kizilcahamam 18-24.VII.[19]72. Pinker" (HRRC); 1♂, "ANATOLIEN, Icel, Kilik. Tauris, Namrun, 37.03N/34.46E, 1400-1800 m, 29.V.-3.VII.[19]79, TÜRKEI, ANATOLIEN 1979 C. Holzschuh, F. Ressl" (HRRC); 1♂, "Dilar syriacus ♂ Nav[ás], 620 Taurus, 48. Asie. Min[or]. Coll. Pictet" (MHN); 1♂, "Syrien, Ehrenberg/Lidar turcicus Hag/388/Type" [The word Type on the old label is wrong] (MFN).

Distribution. Turkey: Western, central, and southern parts of Anatolia (Fig. 31); supposedly reaching Syria or Lebanon to the south.

Etymology. Adjective, masculine, nominative, singular; an attribute to the genus name. From lat. *anatolicus* 3 = referring or belonging to Anatolia, the Asian part of Turkey.

Remarks. *Dilar anatolicus* sp. n. can be distinguished from all other western Palaearctic species of *Dilar* based on the slenderly elongate male ninth gonocoxites and the short, largely membranous male tenth gonocoxites. In appearance, *D. anatolicus* sp. n. looks similar to its co-existing Turkish species *D. turcicus*, but it can be easily distinguished from the latter by the male ninth tergite without median projection and by the different shape of sclerotization of the female bursa copulatrix. Interestingly, *D. anatolicus* sp. n. appears to be closely related to *D. sinicus* Nakahara, 1957, which is distributed in northern China (Zhang et al. 2014a), by having the similar male gonocoxites 9, 10 and 11 with short, shield-like ninth gonocoxite and slenderly elongate tenth gonocoxite. However, in *D. anatolicus* sp. n. the male ninth gonocoxite is largely membranous and transparent with obtuse apex, while in *D. sinicus* the male ninth gonocoxite is entirely sclerotized with acutely pointed apex. Possibly *D. anatolicus* sp. n. occurs sympatrically with *D. syriacus* (see under *D. syriacus*).

Figure 26. *Dilar fuscus* sp. n., holotype, female (HUAC, Vienna), habitus. Scale bar = 1.0 mm.

***Dilar fuscus* sp. n.**

http://zoobank.org/58C2459C-4D54-493A-8A60-DFD0C8F34B49
Figs 26–30

Diagnosis. This species is characterized by the entirely brown wings without distinct markings (at least in the female).

Description. Female. Length of forewing 10.9–12.2 mm, of hindwing 9.9–11.2 mm.

Head brown, with three pale yellow setose tubercles; vertex medially with a blackish brown vittae. Compound eyes blackish brown. Antenna with ca. 25 segments, pale brown.

Prothorax blackish brown, pronotum with pale yellow anterior margin and several yellowish tubercles clothed with brownish hairs; mesothorax and metathorax blackish brown, dorsally yellow at middle. Legs yellowish brown, with each segment blackish brown at tip. Wings entirely brown, without distinct markings. Forewing ~2.5 times as long as wide, with distal half slightly paler; proximally with two or three nygmata, medially with one nygma, which is slightly larger than proximal ones. Hindwing slightly paler than forewing; one nygma present at middle. Veins brown; Rs with six main branches on both fore- and hindwings.

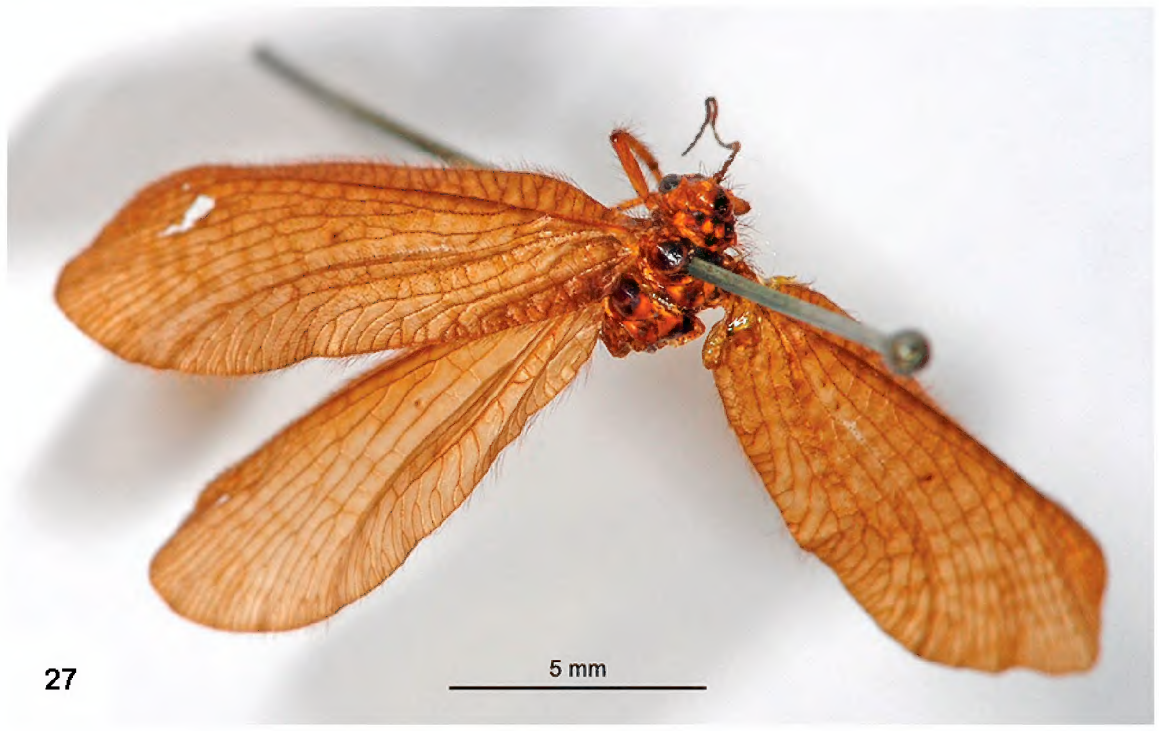
Abdomen pale brown. Ovipositor pale yellowish brown. Seventh sternite in lateral view subtriangular. Eighth abdominal segment without subgenitale. Basal part of bursa copulatrix sac-like, subtriangular in ventral view, most parts membranous and strongly rugose, with ventrolateral portions slightly sclerotized anteroposteriad. Ectoproct rather small, ovoid.

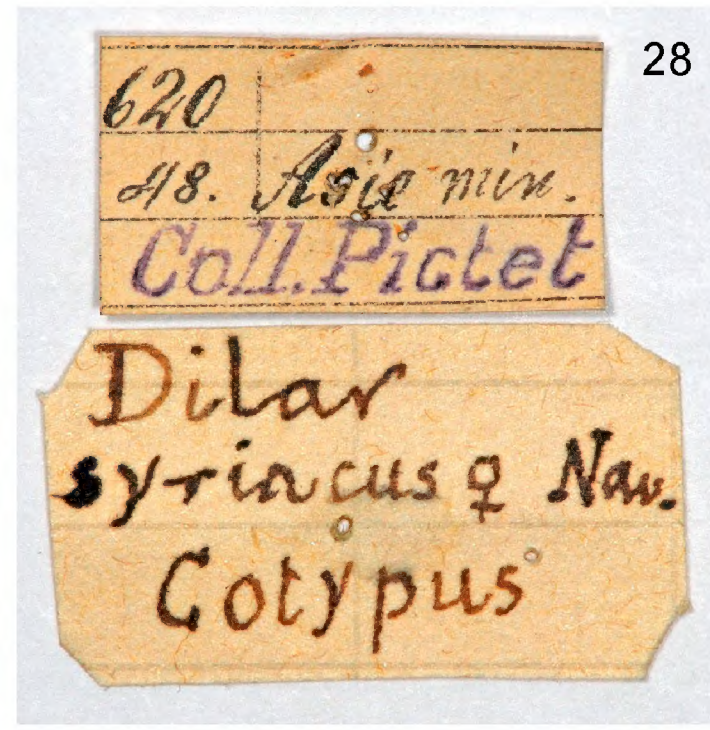
Male. Unknown.

Type material. Holotype ♀, "Prov. AYDIN, Str., Nazilli-Beydağ, 38.01N/28.18E, 650 m, 24.V./SUDWEST-ANATOLIEN-EXP, 1981, H. et U. et Ch. ASPÖCK, H. et R. RAUSCH, F. RESSL" (HUAC). Paratypes: 1♀, same data as holotype (HUAC); 1♀, "Prov. AYDIN, Str. Nazilli – Beydag, 38.01N/28.18E, 650 m, 24.V., SÜDWEST-ANATOLIEN-EXP. 1981, H. et U. et Ch. ASPÖCK, H. et R. RAUSCH, F. RESSL, 81/25" (HRRC); 1♀, "Dilar syriacus ♀ Nav[ás]. Cotypus, 620/48. Asie min[or]. Coll. Pictet" (MHN).

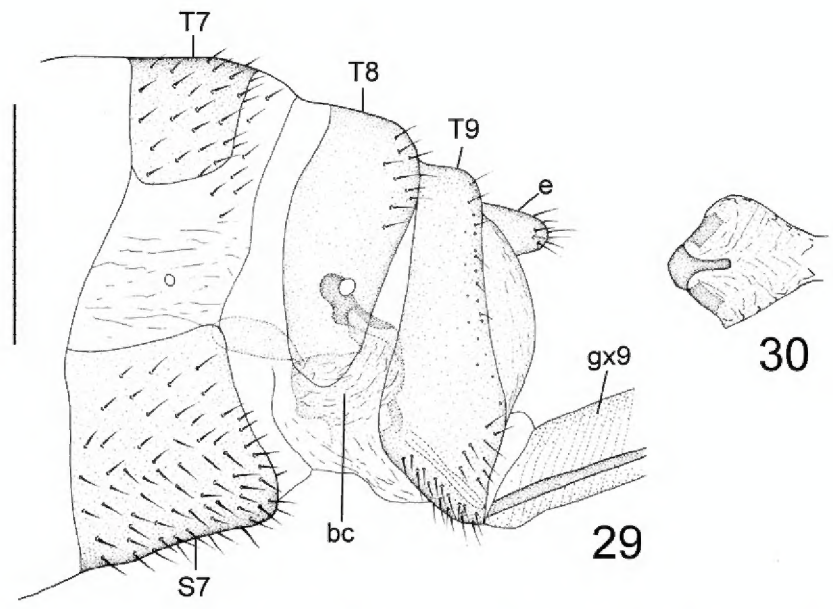
Distribution. The only reliable record of *D. fuscus* sp. n. is from the type locality in western Anatolia (Fig. 31).

Etymology. Adjective, masculine, nominative, singular; an attribute to the genus name. From lat. *fuscus* 3 = dark. The name refers to the dark coloration of the wings.





Figures 27–28. *Dilar fuscus* sp. n., paratype, female (MHN, Genéve). **27.** Habitus; **28.** Labels. [The label "Dilar syriacus Nav. ♀, Cotypus" is wrong].



Figures 29–30. *Dilar fuscus* sp. n. **29.** Female genitalia, lateral view; **30.** Bursa copulatrix, ventral view. Scale bar = 0.5 mm.

Remarks. Despite the unknown male, *D. fuscus* sp. n. is a spectacular new species and can be easily distinguished from all other species of *Dilar* based on the entirely brown wings without distinct markings. The female genitalia of *D. fuscus* sp. n. are principally similar to the co-existing species *D. turcicus* based on the basal part of bursa copulatrix with lateral portions slightly sclerotized. It can, of course, not be excluded that the hitherto unknown male has a different coloration of the wing membrane or even a patterned wing membrane. Such kind of sexual dimorphism has been known from other Dilaridae (Zhang et al. 2015).

Discussion

Three species of the genus *Dilar*, i.e. *D. turcicus*, *D. anatolicus* sp. n. and *D. fuscus* sp. n., are now known from the Balkan Peninsula and Anatolia, with clear specific identities. In the southeast of Europe only *D. turcicus* occurs, while in Anatolia all these three species are present. *Dilar fuscus* sp. n. is known in the female only, which can easily be identified by the unusual dark coloration of the wings (see Figs 26–27). The other two species – *D. turcicus* and *D. anatolicus* sp. n. – can easily be differentiated on the basis of morphological characters of the male genitalia, usually even in dried specimens. *Dilar turcicus* is equipped with a conspicuous median dorsal processus on male ninth tergite, whereas *D. anatolicus* sp. n. lacks this processus. A reliable differentiation of these two species on the basis of coloration and wing marking patterns is – at least presently – not possible.

D. turcicus is a Pontomediterranean faunal element with a distribution comprising large parts of Southeast Europe, probably all major parts of Anatolia, and most probably parts of the Caucasus region. To the best of our knowledge *D. turcicus* is the only representative of the family Dilaridae in the Balkan Peninsula and in the southern parts of East Europe. The northernmost records of this species in Europe are in Croatia, Bulgaria, Ukraine, and Russian north of Caucasus. Most probably the species had survived during the last glacial period in various refugial areas in the southeast of Europe and in Anatolia respectively.

In Anatolia *D. anatolicus* sp. n. and *D. fuscus* sp. n. have been known to us for long, but with respect to the unsolved questions concerning the described species they remained undescribed until now. After examination, re-examination and re-consideration of the three pertinent species – *Dilar turcicus* Hagen, *Dilar syriacus* Navás, and *Dilar lineolatus* Navás respectively – the situation has largely been clarified (concerning *D. syriacus* and *D. lineolatus* as far as possible at present). *Dilar syriacus* (type locality: probably surroundings of Beirut) remains a nomen dubium, it cannot be excluded that it will turn out to be identical either with *D. turcicus* (then it would be a junior synonym) or with *D. anatolicus* sp. n. (then it would become a senior synonym). However, it may also be a species different from both.

D. lineolatus has erroneously been associated with Anatolia. The species has been described from the region of Tekke in Turkmenia (probably today in Turkmenistan)

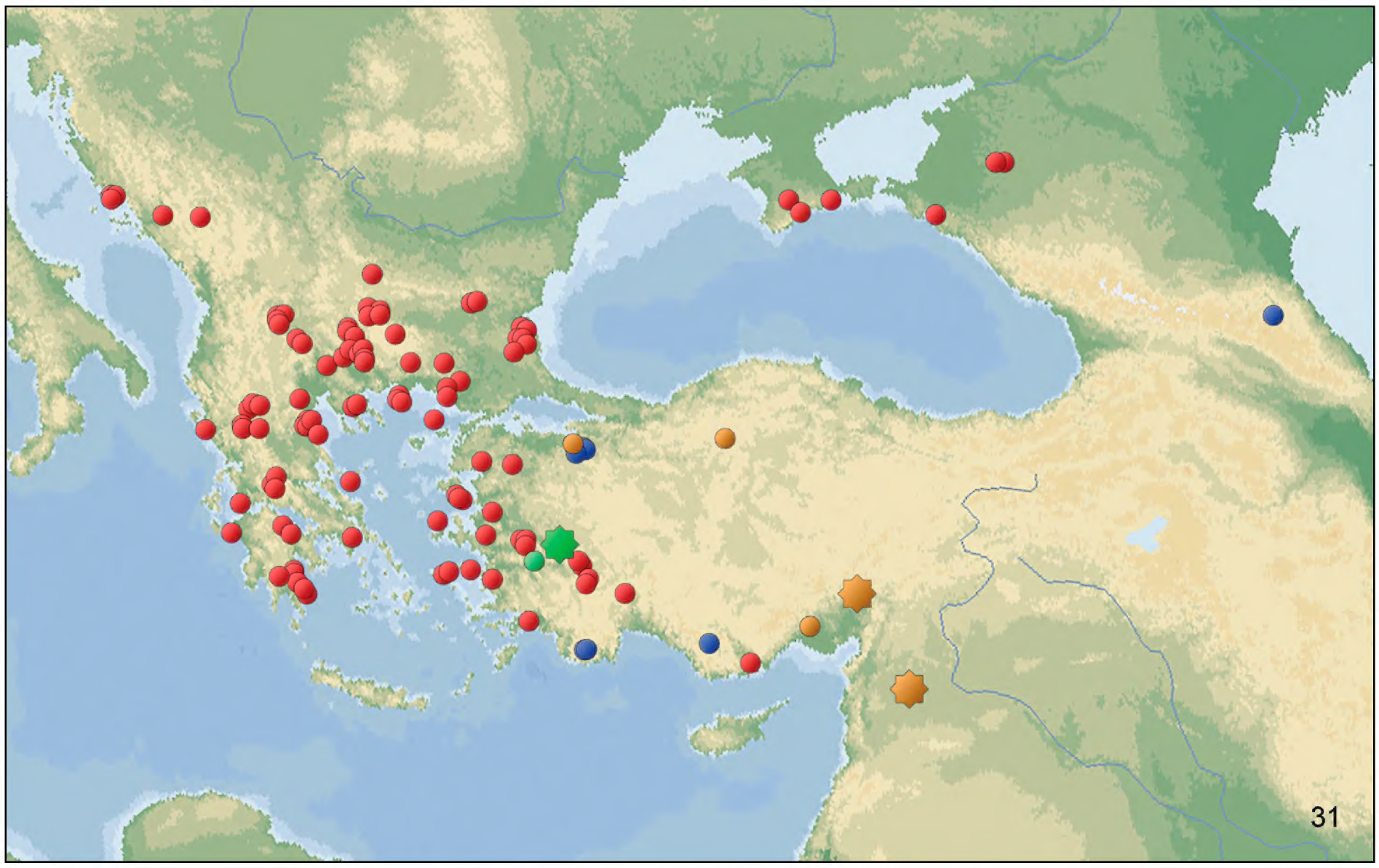


Figure 31. Distribution of Dilaridae in Southeast Europe and Anatolia (see geographical coordination and references of distribution records in Suppl. materials 1–2). Red = *D. turcicus*; brown = *D. anatolicus* sp. n.; green = *D. fuscus* sp. n.; star = identified specimens without exact locality; blue = *Dilar* sp.

and does presumably not occur in Anatolia. The existing remains of the damaged holotype cannot be assigned to any of the known species of *Dilar*.

Acknowledgements

We want to express our grateful thanks to a number of colleagues who have helped substantially in this study: Philip D. Perkins and Rachel Hawkins (MCZ) organized, promoted and speeded the sending of photographs and finally the syntype of D. turcicus from Armenia which became the lectotype and thus the precondition for the taxonomy in this paper. Michael Ohl and Lukas Kirschey (MFN) have sent photographs of the other syntype of D. turcicus and of the type of D. lineolatus and a further specimen which turned out to represent *D. anatolicus* sp. n. Peter J. Schwendinger (MHN) provided specimens from the Pictet collection. Hubert and Renate Rausch (Scheibbs) entrusted their enormous Dilaridae collection to us for this study. Antoine Mantilleri (MNHN) helped us committedly to get into contact with the persons curating the Neuropterida collection. Several specimens of *D. anatolicus* sp. n. and of *D. turcicus* respectively in the HUAC were collected by the following entomologists: Ernst Arenberger, Georg Friedel †, Carolus Holzschuh, Friedrich Kasy †, Josef Klimesch †, Hans Malicky, Franz Ressl †, Alfred Radda and Josef Thurner †. Harald Bruckner (NHMW) deserves our special gratitude for providing the database of all the records, for producing the distribution map and finally for photographs, especially for the focus stacking images of the genital sclerites of the lectotypus of *D. turcicus*. We gratefully acknowledge the valuable input of the reviewers. This research was supported by the National Natural Science Foundation of China (Nos. 31322051 and 31320103902).

References

Aspöck H, Aspöck U (1968) Zwei weitere neue Spezies des Genus *Dilar* Rambur (Neuroptera, Planipennia) aus Asien (Vorläufige Mitteilung). Entomologisches Nachrichtenblatt, Wien 15: 3–6.

Aspöck H, Aspöck U, Hölzel H (1980) Die Neuropteren Europas. 2 vols. Goecke & Evers, Krefeld, 495 pp, 355 pp.

Aspöck H, Hölzel H, Aspöck U (2001) Kommentierter Katalog der Neuropterida (Insecta: Raphidioptera, Megaloptera, Neuroptera) der Westpaläarktis. Denisia 2: 1–606.

Aspöck U, Aspöck H (2008) Phylogenetic relevance of the genital sclerites of Neuropterida (Insecta: Holometabola). Systematic Entomology 33: 97–127. doi: 10.1111/j.1365-3113.2007.00396.x

Canbulat S (2007) A checklist of Turkish Neuroptera with annotating on provincial distributions. Zootaxa 1552: 35–52.

Canbulat S, Kiyak S (2005) Contribution to the Fauna of Neuroptera (Insecta) of South-Western Anatolia. Annals of the Upper Silesian Museum (Entomology) 13: 9–60.

Devetak D (1991) Neuropteroidea. Megaloptera, Raphidioptera, Planipennia (Insecta). Fauna Durmitora 4: 135–159.

Devetak D (1992a) Megaloptera, Raphidioptera and Planipennia (Neuropteroidea, Insecta) of Croatia. Znanstvena Revija 4: 89–114.

Devetak D (1992b) Present knowledge of the Megaloptera, Raphidioptera and Neuroptera of Yugoslavia (Insecta: Neuropteroidea). In: Canard M, Aspöck H, Mansell MW (Eds) Current Research in Neuropterology. Proceedings of the 4th International Symposium on Neuropterology. Bagnères-de-Luchon, France. Toulouse, 107–118.

Devetak D, Klokočovnik V, Rausch H, Janžekovič F (2015) Fauna of the Neuropterida (Raphidioptera, Neuroptera) of the Protected Area Jasen, Macedonia: a summer flash. Turkish Journal of Zoology 39: 15–27. doi: 10.3906/zoo-1305-43

Ghilarov MS (1962) The larva of *Dilar turcicus* Hag. and the position of the family Dilaridae in the order Planipennia. Entomologicheskoe Obozrenie 41: 402–416.

Hagen HA (1858) Russlands Neuropteren. Stettiner Entomologische Zeitung 19: 110–134.

Hagen HA (1860) Neuroptera Neapolitana von A. Costa, nebst Synopsis der Ascalaphen Europas. Stettiner Entomologische Zeitung 21: 38–56.

Hagen HA (1866) Die Neuropteren Spaniens nach Ed. Pictet's Synopsis des Neuroptères d'Espagne. Genève 1865. 8. tab. 14 col. und Dr. Staudingers Mittheilungen. Stettiner Entomologische Zeitung 27: 281–302.

Kiyak S, Özdikmen H (1993) Über einige neuropterenarten von Soguksu National park (Kizilcahamam, Ankara). Priamus 6: 156–160.

Kovanci OB, Kovanci B (2015) Contribution to the knowledge of Mantispoidea, Osmyloidea, and Myrmeleontidea with new records for the Neuroptera fauna of northwestern Turkey. Turkish Journal of Zoology 39: 110–118. doi: 10.3906/zoo-1401-45

Legrand J, Lachaise M (1994) Les Dilaridae de Navás conservés dans les collections nationales (MNHN, Paris) [Neuroptera]. Revue Française d'Entomologie (N.S.) 16: 87–92.

Minter LR (1986) The first record of Dilaridae (Neuroptera) from the Afrotropical Region. Journal of the Entomological Society of Southern Africa 49: 87–94.

Monserrat VJ (1988) Revisión de la obra de L. Navás, I: El genero *Dilar* Rambur, 1842 (Neuropteroidea, Planipennia: Dilaridae). Neuroptera International 5: 13–23.

Monserrat VJ (2014) Los diláridos de la Península Ibérica (Insecta: Neuropterida: Neuroptera: Dilaridae). Heteropterus Revista de Entomologia, 14: 187–214.

Monserrat VJ, Triviño V (2013) Atlas de los neurópteros de la Península Ibérica e Islas Baleares (Insecta, Neuroptera: Megaloptera, Raphidioptera, Planipennia). Monografias S.E.A., Sociedad Entomológica Aragonesa 13: 1–154.

Navás L (1903) Diláridos de España. Memorias de la Real Academia de Ciencias y Artes de Barcelona (3) 4: 373–381.

Navás L [1909] (1908–1909) Monografía de la familia de los Diláridos (Ins. Neur.). Memorias de la Real Academia de Ciencias y Artes de Barcelona (3) 7: 619–671.

Navás L (1913) Mis excursiones por el extranjero en el verano de 1912 (25 julio–16 septiembre). Memorias de la Real Academia de Ciencias y Artes de Barcelona (3) 10: 479–514.

Navás L (1914) Family Dilaridae. Neuroptera. Genera Insectorum 156: 1–14.

Navás L (1925) Les dilarides (Ins. Névroptères) du Muséum National de Paris. Bulletin du Muséum National d'Histoire Naturelle, Paris (1) 31: 188–189.

New TR (1986) A review of the biology of Neuroptera Planipennia. Neuroptera International, Supplemental Series 1: 1–57.

New TR (1989) Planipennia, Lacewings. Handbuch der Zoologie, Vol. 4 (Arthropoda: Insecta), Part 30. Walter de Gruyter, Berlin, 132 pp.

New TR (2003) The Neuroptera of Malesia. Fauna Malesiana vol. 4, Brill, Leiden, VIII + 204 pp.

Oswald JD (1998) Annotated catalogue of the Dilaridae (Insecta: Neuroptera) of the world. Tijdschrift voor Entomologie 141: 115–128. doi: 10.1163/22119434-99900008

Oswald JD, Schiff NM (2001) A new species of the genus *Dilar* Rambur (Neuroptera: Dilaridae) from Borneo. Proceedings of the Entomological Society of Washington 103: 74–80.

Pongrácz S (1913) Újabb adatok Magyarország Neuroptera-faunájához. Rovartani Lapok 20: 175–186.

Popov A (1964) What do we know on the distribution of Neuropteroidea in Bulgaria. Priroda 13: 68–72. [In Bulgarian]

Popov A (1993) Raphidiopteren und Neuropteren aus Bulgarien in den Sammlungen des Nationalmuseums in Prag. Historia Naturalis Bulgarica 4: 16–28.

Popov A (2001) The snakeflies and the lacewing insects (Insecta: Raphidioptera and Neuroptera) of the Kresna Gorge (SW Bulgaria). In: Beron P (Ed.) Biodiversity of Kresna Gorge (SW Bulgaria). National Museum of Natural History, Sofia, 131–143. [In Bulgarian]

Popov A (2002) Zoogeographical analysis of Neuroptera in Bulgaria. Acta Zoologica Academiae Scientiarum Hungaricae 48: 271–280.

Popov A (2004) List of Raphidioptera, Neuroptera and Mecoptera published from the Eastern Rhodopes (Bulgaria and Greece). In: Beron P, Popov A (Eds) Biodiversity of Eastern Rhodopes (Bulgaria and Greece). National Museum of Natural History, Sofia, 371–378.

Popov A (2007) Distribution of the families of Neuroptera with low species diversity in Bulgaria. In: Pantaleoni RA, Letardi A, Corazza C (Eds) Proceedings of the 9th International Symposium on Neuropterology, Ferrara 20-23 June 2005. Annali del Museo Civico di Storia Naturale di Ferrara 8: 117–130.

Rambur MP [1838] (1837–1840) Faune entomologique de l'Andalousie. Vol. 2. Paris.

Zakharenko AV (1982) O faune i prakticheskom znachenii setchatokrylykh Ukrainy [= On the fauna and practical meaning of the lacewings in the Ukraine]. Sbornik nauchnykh trudov Khar'kovskogo Sel'sko-Khozyaistvennogo Instituta [= Transactions of the Kharkov Agricultural Institute] 282: 20–24. [In Russian]

Zakharenko AV (1988) Setchatokrylye (Neuroptera) fauny SSSR. II. Semeistva Dilaridae, Berothidae i Sisyridae [= Neuroptera of the fauna of the USSR. II. Fam. Dilaridae, Berothidae and Sisyridae]. Entomologicheskoe Obozrenie 67: 763–768. [In Russian]

Zakharenko AV, Krivokhatsky VA (1993) Setchatokrylye (Neuroptera) evropeiskoi chasti byvshego SSSR [= Neuroptera from the European part of the former USSR]. Izvestiya Kharkovskogo Entomologicheskogo Obshchestva [= Kharkov Entomological Society Gazette] 1: 34–83. [In Russian]

Zhang W, Liu XY, Aspöck U, Aspöck H (2014a) Revision of Chinese Dilaridae (Insecta: Neuroptera) (Part I): Species of the genus *Dilar* Rambur from northern China. Zootaxa 3753: 10–24. doi: 10.11646/zootaxa.3753.1.2

Zhang W, Liu XY, Aspöck U, Aspöck H (2014b) Revision of Chinese Dilaridae (Insecta: Neuroptera) (Part II): Species of the genus *Dilar* Rambur from Tibet. Zootaxa 3878: 551–562. doi: 10.11646/zootaxa.3878.6.3

Zhang W, Liu XY, Aspöck H, Winterton SL, Aspöck U (2014c) Species of the pleasing lacewing genus *Dilar* Rambur (Neuroptera, Dilaridae) from islands of East Asia. Deutsche Entomologische Zeitschrift 61: 141–153. doi: 10.3897/dez.61.8793

Zhang W, Liu XY, Aspöck H, Aspöck U (2015) Revision of Chinese Dilaridae (Insecta: Neuroptera) (Part III): Species of the genus *Dilar* Rambur from the southern part of mainland China. Zootaxa 3974: 451–494. doi: 10.11646/zootaxa.3974.4.1

Supplementary material 1

Sources of records upon which the distribution map is based

Authors: Ulrike Aspöck, Xingyue Liu, Horst Aspöck

Data type: records data

Supplementary material 2

Records on which the distribution map is based

Authors: Ulrike Aspöck, Xingyue Liu, Horst Aspöck

Data type: records data